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(54) Seal device for interposition between a pump body and pump impeller.

(57) The present invention concerns a seal device (1) interposed between an impeller (5) and a pump body (4). That device is composed of a seal ring (15), encircling the forward portion (9) of the impeller (5), which is accommodated in a seat (14) formed on the pump body (4). The seat (14) has such dimensions as to allow radial movement of the ring (15) on its interior. Furthermore, there is provided a means (11) of allowing a pressure force to act on the sealing element (15) at least at a portion thereof facing the forward portion (9) of the impeller (5).

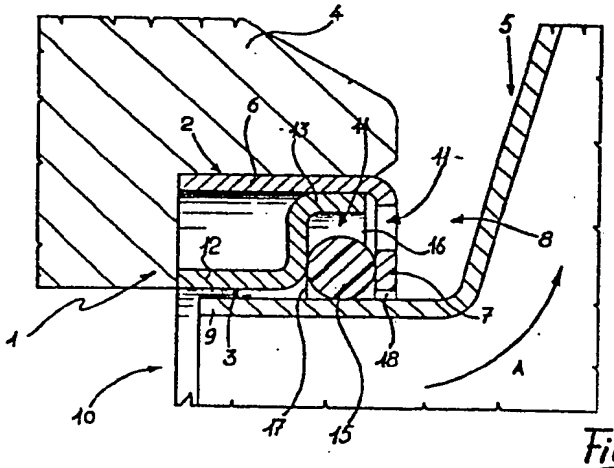

Fig.1

EP 0 167 837 A1

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"SEAL DEVICE FOR INTERPOSITION BETWEEN A PUMP BODY AND PUMP IMPELLER"

This invention relates to a seal device, particularly of a type for interposition between a pump body and pump impeller.

In current commercial production of electric pumps, the level of accuracy must be kept within acceptable limits for the economy of the product.

For this reason and owing to the number of the pieces subjected with their couplings to tolerance of average precision, centrifugal pumps utilise a seal ring placed between the impeller port and pump body which restricts its radial play.

A problem encountered with prior types is connected with the scraping action undergone by that ring in operation, which in time jeopardises its integrity.

Further, even after significantly long inoperative periods, that scraping action may result in the impeller being seized on starting.

Such drawbacks are due to the inverse proportionality that relates the radial play to the volumetric efficiency of the pump.

In fact, the greater is the play, the more reliable the impeller rotation becomes, and accordingly, the lesser becomes the risk of seizure thereof, since the hydraulic losses of a centrifugal pump depend on the rationality of the impeller and pump body shapes, as well as the recycles of liquid which are created therein.

It is a primary aim of the invention to obviate such prior drawbacks affecting known pump types by providing a

seal device which can ensure, in the rotation geometry of the impeller, a reliable rotation which causes no scraping of the seal element.

A further important object is to provide a device which affords maximisation of the hydraulic performance while minimising the recycle flow.

A main object is also that of providing a device which can simultaneously achieve the two preceding objects.

Another object is to provide a device which allows the utilisation of ring seals of suitable materials also for specific liquids and temperatures.

These and other objects are achieved by a seal device for interposition between a pump impeller and pump body of single or multistage type, which is characterized in that it comprises at least one seal element encircling a portion of an impeller, said at least one seal element being accommodated in at least one seat provided on the pump body, said seat being adapted for allowing radial movement of said seal element therein, there being provided a means for allowing a pressure force to act on the seal element, at least at a portion thereof facing said portion of said impeller.

It will be understood that the device of this invention may be used also in multistage pumps in connection with all of some of the impeller stages.

Further features and advantages of the invention will be apparent from the following detailed description of a preferred, but not exclusive, embodiment of a device according to the invention, with reference to the

accompanying illustrative but not limitative drawings, in which:

Figure 1 is a sectional view taken on the longitudinal centreplane peripheral portion of the device according to a first embodiment as mounted between a pump body and an impeller;

Figure 2 is a similar view to Figure 1, showing another embodiment of the device according to the invention; and

Figure 3 is a fragmentary axial section of a multi-stage centrifugal pump in which the device of this application is applied.

With reference to the cited figures, the device 1 comprises two rings 2 and 3 positionable between the pump body 4 and impeller 5 of any centrifugal pump.

The ring 2, having an essentially L-like cross-sectional shape is spot welded and rests with the longer flange 6 on the pump body 4, while the other flange 7, perpendicular to the axis of the impeller 5, contacts the zone 8 located downstream from the inlet end of the intake or port 9.

In the zone 8 there is present the fluid centrifuged by the impeller 5, which is subjected to a higher pressure than that prevailing in the suction zone 10. In fact the zone 8 is enclosed by the body 4 of the pump within the cavity or compartment thereof where the impeller 5 rotates between the inner walls of the pump body and the impeller. Within the zone 8 the fluid is substantially stagnant but it takes up the delivery pressure of the pump, the liquid flowing according to the

arrow A through the hollow interior of the impeller owing to the centrifugal action thereon.

The flange 7 has a plurality of openings 11 formed proximately to the point of connection with the flange 6.

The second ring 3 has an essentially S-like cross-sectional shape, with the bottom lug or flange 12 being slightly longer than the upper lug or flange 13.

The upper lug 13 abuts and is spot welded on the flange 6 of the ring 2, while the bottom lug 12 is disposed parallel to that same flange and rests with its free end on the pump body 4.

The rings 2 and 3 define a groove or seat 14, whose base is defined by the upper lug 13 of the second ring 3 for a sealing element 15 comprising, for example, a circular cross-section elastomer ring.

The seat 14 has a greater depth than the external diameter of the element 15, or corresponding external dimension of a sealing element having other than a circular cross-section, so that a chamber 16 is defined between the base of said seat 14 and a portion of said sealing element.

The device 1 operates as follows: on operating the pump, the pressurized liquid present in the zone 8 will flow, through the openings 11, into the chamber 16 of the seat 14.

That liquid pressure urges the sealing element or elastomer ring 15 against the external circumferential face of the intake 9 of the impeller 5 because the fluid working in the zone 17 has a much lower pressure than that in the zone 8.

The liquid present in this latter zone 8, however, tends to leak out also through the space 18, and below the element 15, thus forming, in a condition of equilibrium, a ring or film of liquid, for lubricating the sliding motion between the sealing element 15 and the port 9 of the impeller 5, its thickness being such as to ensure a minimal recycle of the liquid, and hence, a high volumetric efficiency, whilst avoiding any scraping action occuring between the sealing element and the impeller.In fact, the sealing element is held stationary within the seat 14.

It will be understood that a slight radial displacement of the sealing element 15 under the action of the pressure forces as above explained is made possible by the elastic nature of the sealing element 15.

It will be further noted that the pressure in the zone 14 is somewhat greater than the pressure in the zone 17 owing to the pressure drop caused by the leaks through the space 18 and the communication with the section side of the pump. Therefore the ring 15 is urged radially inwards and allows compensation.

Thus, it has been shown how the pressure compensating seal device according to the invention can act on a sealing element to achieve all of the objects set forth, while also allowing the seal element to be self-centering, owing to the provision of the chamber 16 and the working pressure forces existing therein and, thereby accommodating any lack of coaxiality between the forward portion or shaft of the impeller 5 and the seat 14.

The ring or sealing element 15 is also self-

compensated, by virtue of the fact that, the higher the pressure in the pump becomes, consequently, the greater become the forces applied by the fluid, to the sealing element, thereby compensating the play existing between its surface and the outer circumferential surface of the port or forward portion 9 of the impeller 5.

The invention herein is susceptible to many modifications and variations without departing from the purview of the inventive concept, one further embodiment of which is illustrated in Figure 2, where reference numerals increased by one hundred, indicate like-parts, described heretofore.

Thus, as an example, where a semirigid sealing element 115 e.g. of plastics material such as a wear ring is to be used, the device 101 could also include two rings 102 and 103, but with the latter being formed with a guide 119 projecting into a correspondingly shaped seat 114, provided on the element 115. Instead of a semirigid ring of plastics material also an elastic metallic split ring may be used.

This will advantageously allow, for the self-centering feature of the element itself, in the space between its surface 115a and outer surface of the intake 109, to be held constant and at a minimum.

Of course, any materials may be used contingent on requirements, such as the type and temperature of the liquid being pumped.

CLAIMS

1. A seal device (1,101) for interposition between a pump impeller (5,105) and pump body (4,104) of single or multi-stage type, characterized in that it comprises at least one seal element (15,115) encircling a portion (9,109) of an impeller (5,105), said at least one seal element (15,115) being accommodated within a housing means (14,114) provided on the pump body (4,104), said housing means (14,114) being adapted for allowing radial movement of said seal element (15,115) therein, there being provided means (11,111) for allowing a pressure force to act on the seal element (15,115), at least at portion thereof facing said portion (9,109) of said impeller (5,105).

2. A seal device according to Claim 1, characterized in that housing means (14,114) has a greater radial extension than said seal element (15,115).

3. A seal device according to Claims 1 and 2, characterized in that means for allowing a pressure force to act comprises a plurality of openings (11,111), formed in said housing means (14,114), said openings (11,111) being adapted for communicating the delivery pressure of the fluid being centrifuged by the impeller (5,105) to said portion of the seal element (15,115) which lies opposed to said portion (9,109) of the impeller (5,105).

4. A seal device according to Claims 1 and 3 characterized in that said housing means comprises at least one seat (14,114) formed of two rings (2,3,102,103), the former (2,102) defining a substantially L-like cross-section including a longer flange (6,106) which is rigid

with the pump body (4,104) and a shorter flange (7,107) located downstream from said portion (9,109) of the impeller (5,105), the latter ring (3,103) defining a substantially S-like cross-section including a lug (13,113) made rigid with said longer flange (6,106) of the former ring (2,102) to define the base of said seat (14,114).

5. A seal device according to Claims 1 to 4 characterized in that the seal element (15) comprises an elastomer ring.

6. A seal device according to Claims 1 to 4, characterized in that the seal element (115) comprises a rigid wear ring, said ring having a laterally located seat (114) adapted for radial sliding movement on a matchingly shaped guide (119) formed on said ring (103).

7. A pump having a sealing device according to claims 1-6.

8. A multi-stage centrifugal pump having in at least one stage thereof a sealing device as claimed in claims 1-6.

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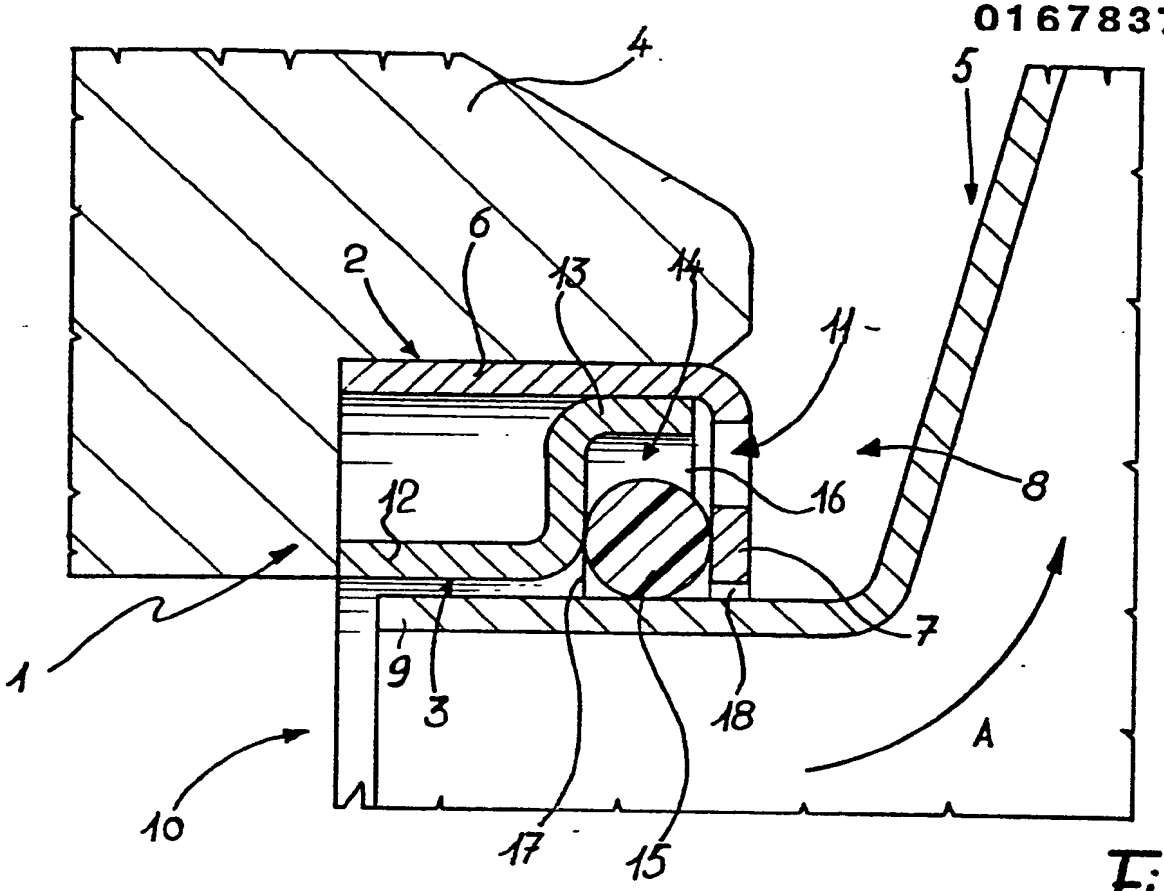


Fig.1

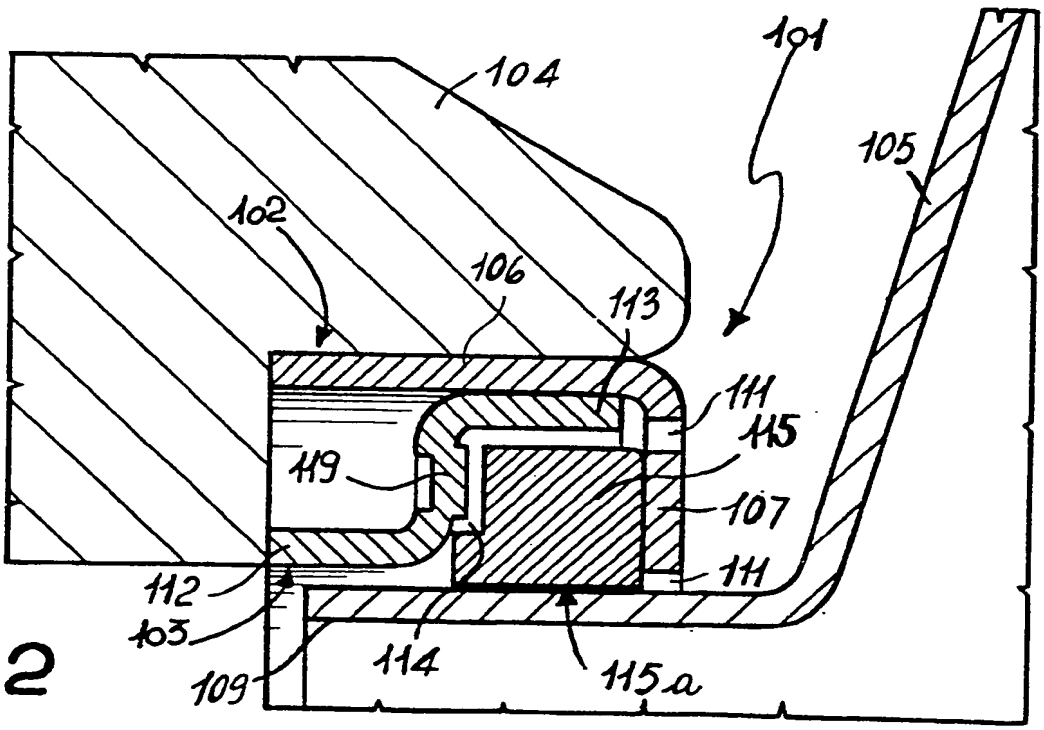
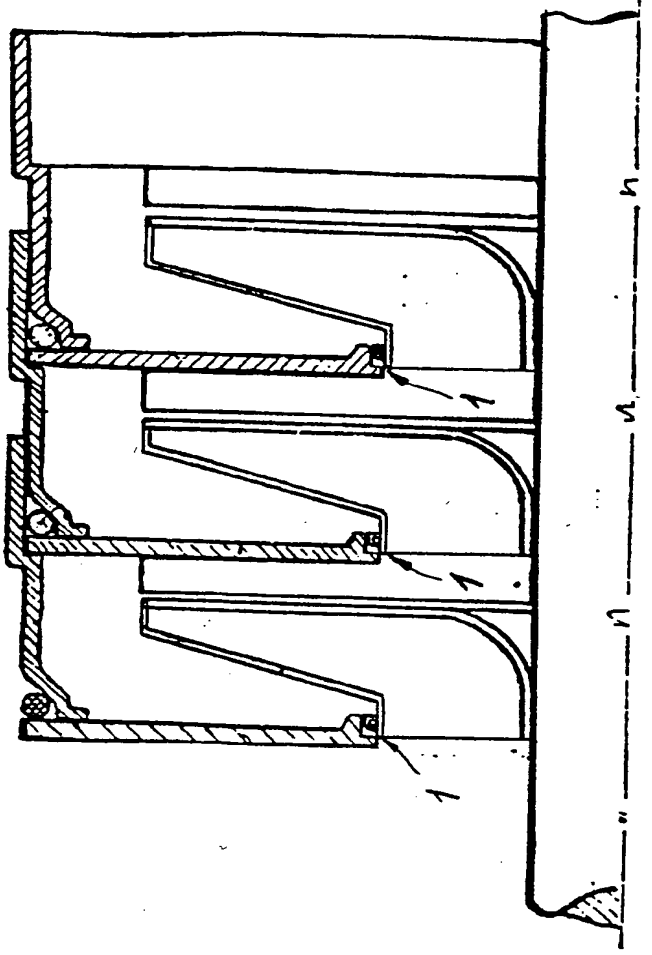


Fig. 2

Fig.3



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EUROPEAN SEARCH REPORT

Application number

EP 85 10 7012

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	US-A-3 779 667 (JOHNSON) * Column 1, lines 52-59; column 2, lines 11-56; figures *	1,2,5,7	F 04 D 29/16
A		4	

Y	US-A-3 741 679 (JOHNSTON) * Column 5, line 61 - column 6, line 12; figures 1,2 *	1,2,5,7	
A		3	

Y	US-A-2 162 486 (LE TOURNEAU) * Page 1, left-hand column, lines 31-48 and right-hand column, lines 5-34; figures 1,2; page 2, left-hand column, lines 8-26 *	1,3,7	
A		4	

Y	US-A-1 783 427 (JENNINGS) * Page 1, lines 68-100; figures 1,2,4 *	1,2,7	
A		3,4,6	
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TECHNICAL FIELDS SEARCHED (Int. Cl.4)

F 04 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27-09-1985	KAPOULAS T.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	US-A-1 369 508 (WEINER) * Page 1, lines 57-98, figures I,II and line 108 - page 2, line 8, figure IV *	1,5,7, 8	
A		2,4	

Y	GB-A- 748 827 (BALCKE) * Page 2, lines 46-87, figure 1; page 3, lines 1-8, figure 2 *	1,3,7, 8	
A		4,6	

A	US-A-3 578 874 (SPROULE) * Column 1, line 54 - column 2, line 14, figure *	1,4,6	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

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